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REGIONAL POPULATION GROUPS OF ATACAMA,  
PART II—(CONCLUSION).\*

BY

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THE PAYTA AND PIURA VALLEY REGION.

At the comparatively busy port of Payta, in northwestern Peru (see map, p. 143), one finds an export trade in cotton, rice, and sugar, and the markets, for all the sterility of the immediate desert, are crowded with tropical fruits. As in so many cases along the coast of Peru, the busy port is but the reflection of a rich and distant hinterland where water from the mountains is directed to the service of man. Such is the relation of the forbidding region about the port of Lomas to the rich Lomas Valley, of Salaverry to Truxillo, and of Payta to Piura.

The best account of the Piura Valley (east of the port of Payta) yet written was published in 1895 by A. F. Sears.† He describes the tremendous burst of life that the inconstant rains bring to the thirsty land. For a week or a month, cattle and great herds of goats wander out of the irrigated valleys and revel in the fresh pastures on the plateau. What with their close grazing, and the increasing dryness, the desert soon reverts to its original condition. The brilliancy of this short, moist period is little short of marvelous. The red-petaled papita of San Juan decks the heretofore naked plain, and innumerable species of *Oxalis*, *Crucifers*, and *Amaranth*s occur, living on the nourishment drawn by their long, penetrating

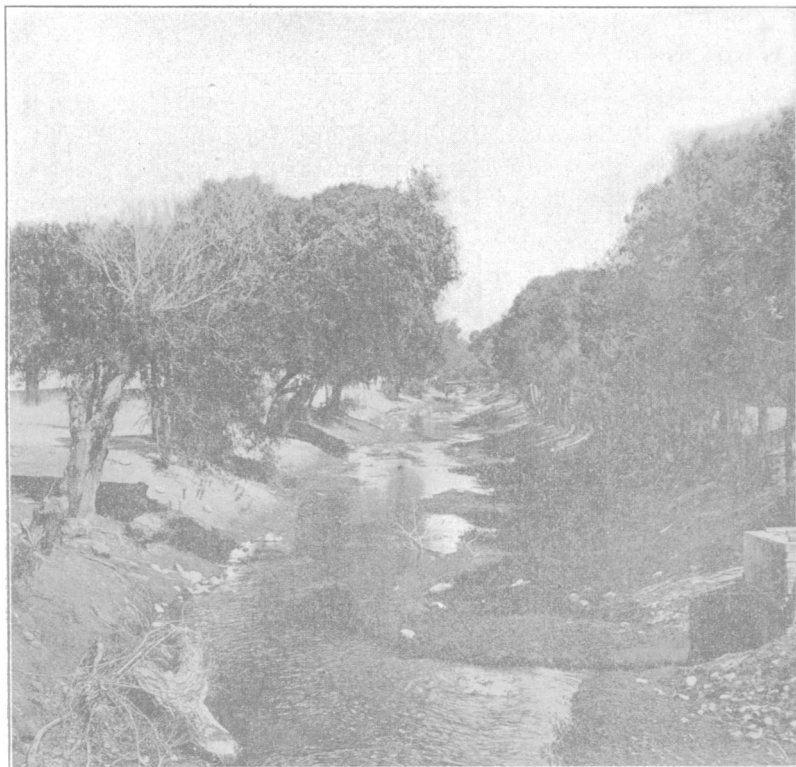
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\* Part I printed in BULLETIN, March, 1909.

† BULL. Am. Geog. Soc., Vol. 27, No. 3, 1895.

roots. The algarroba, a stunted honey locust or mimosa, growing in the valleys, springs up on the plain, likewise the sapote del perro (sapodilla), so called because the hungry dogs of the valley towns roam over the pampas in search of its fruit.

There is an interesting story current in Piura concerning a novel human response to these irregular rains. An enterprising cholo or half-breed built an inn in the middle of the desert and furnished



IRRIGATION DITCH AT PACASMAYO, PERU.

Poplars and willows live on the banks and retard evaporation, which is excessive in this dry climate. Their roots are supplied by seepage and serve also partially to protect the banks from scour. The canal is bordered by prosperous farms and gardens for many miles.

food and water to travellers, getting these supplies from the port 20 odd miles away. No sooner had he become well established than the owner of a distant hacienda demanded rent for the bit of desert land. The rent was paid perforce because the claimant had a grant from the Spanish crown by which it was shown that the hacienda extended toward the foothills of the Andes *as far as the goats*

*could go before they returned to the river for water; and it was known that every seven years the goats of this hacienda went far beyond the position of the inn before they returned to the River Chira!*

The thorough wetting of the desert, about every seven years, results in five crops, two each year, and then the land rests until the end of the seven-year cycle, except in the valley bottoms where irrigation maintains the fertility of the soil.

When the floods are due the people ask every traveller from up valley where the river was when he passed. If he reports it coming, a crowd of eager listeners and questioners surround him as if he brought, as indeed he does bring, important news. As it approaches the upper haciendas the Indians turn out to welcome it with fife and drum and fire rockets. The news is passed around that the river is but a league away and will be here to-day. The people ride out to meet it and no fiesta in northern Peru is equal to the one on this occasion when the now tireless multitude goes out to seek the river. The affair reaches a climax when the river, at first a tiny rill, arrives at the bridge of Piura where commonly 5,000 people turn out to escort the river to the city. At the city of Catacaos (25,000 population, and the fifth city of Peru\*), 6 miles lower down the valley, it is met by 15,000 people, so that the river has a triumphant march from the mountains to Sechura, where it enters the sea.

These eager inquiries for the river suggest those which are reported from Arabia. The infrequent thunder storms of spring scatter their showers so irregularly that one place, a few miles square, may be abundantly watered while all the rest of the Arabian desert, for leagues around, may continue parched and lifeless. The shepherd searches for these watered places constantly and every traveller who passes by is hailed for information as to the amount of the rain and the state of the pasture.†

The cotton of Piura is one of the most celebrated varieties in the world and experiments looking toward its production elsewhere have resulted uniformly in failure. It has a long, woolly and exceedingly tough fibre and is distinctly the product of local climatic conditions, hence the Piurians have a monopoly of its culture. The whole valley is largely given up to its production, for its market value is twice that of ordinary cotton. It is produced in twelve shades, ranging from a pure white through buff, pink and light

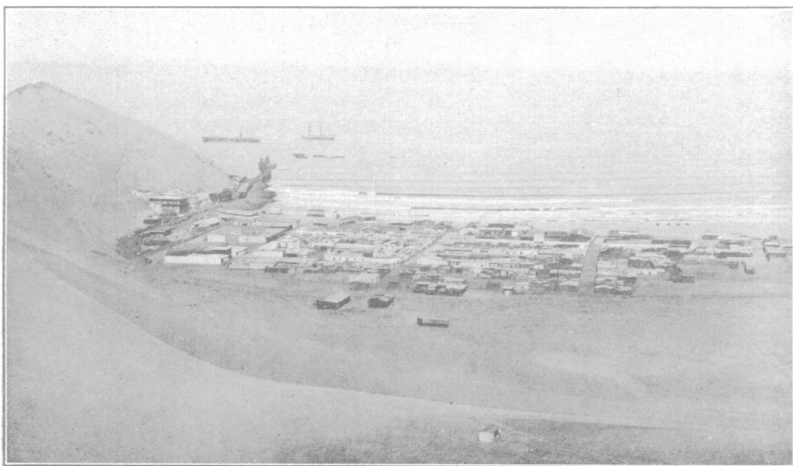
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\* Sievers, *Süd-und Mittel-Amerika*, p. 446.

† Doughty, "Arabia Deserta."

brown to a rich, dark red brown, and is used in the manufacture of fine underwear and hosiery and in the adulteration of fine woollens as a protection against shrinking.

Besides cotton, some sugar and rice are produced for export, in especially large quantities after each 7-year rain. During a call at the port in September, 1907, Chinese rice was being imported by a Japanese firm, in a British steamer, manned by a Japanese crew. The cheaper and inferior Chinese rice was imported for the labourers of the Piura Valley and the superior crop of rice the Piurians themselves had produced was exported to Chile and Europe leaving a net profit, of considerable amount, for the hacenderos.



THE PORT OF SALAVERRY, PERU.

A typical coast town, whose size and general aspect are not at all comparable to the fertile Chimu Valley and the city of Truxillo, with which it has connection by rail. Such coast ports in Peru often have a most forbidding appearance, but are not safe indications of the conditions of the hinterland, where irrigation from mountain streams maintains a high degree of fertility.

The borders of the mountain streams that cross the desert plateau are lined with algarroba trees and the exceptional culture of these is one of the characteristics of the Piura Valley. During the dry season, when forage on the flood plain is limited or exhausted, the cattle, goats, and donkeys thrive upon its foliage and the long green pods it bears in incredible quantities. It even supplies food to the people. The trunks and branches and long thick roots of the dead algarroba trees are burned for fuel. Charcoal is also manufactured from it in great quantities for export to Eten, Salaverry, Callao, and even Iquique, where it brings 40-50 cents per quintal (100 lbs.) The goats, that hunt the desert for every scrap of succulent herbage

and are herded in the valleys in great numbers, are a source of revenue for their skins chiefly. These are shipped out of the country for manufacture and bring, in Peru, 40 to 50 cents per pound. A goat skin weighs, on the average, about 2 or 2½ pounds.

The Piura is like the Nile in the relation it bears to its waiting people. The river rises once every year and to exceptional heights once about every seven years. In times of unusual flood two crops may be produced even on the farther portions of the flood plain. The St. John's crop is harvested in August or September and the Christmas crop late in December or early in January. The latter is but half or two-thirds the size of the former. The seed for it is planted in March and, as 10 months are required for the growth and maturity of the crop, it matures during the drier portion of the year. In 1906 the river did not supply as much water as usual and the Christmas crop was only about 2,500 bales. There was a good overflow following the harvest and the St. John's crop for 1907 was estimated at 30,000-40,000 bales.

#### THE COPIAPÓ-COQUIMBO REGION.

The classic description of the southern end of the great coast desert is that by Darwin\*, whose notes, although written in 1845, are more illuminating of that section to-day than the hurried observations of all others who have since written of this land. It is customary to write of the desert section of Chile as a country of interest only through its mineral resources of nitrate, copper, and tin. This treatment ignores the populations of greatest anthropogeographic interest—the isolated, unaffected, local groups of indigenous peoples who cling with independence to the watered areas of the desert. Except for slight and obvious modifications, Darwin's description is applicable to the country to-day.

Valparaiso, or Valley of Paradise, practically on the southern border of the desert, was so named because it was the first green valley seen from the Spanish caravels as they coasted south from Callao. Yet it, too, is a land of uncertain rain and that joyful designation of its first white visitors would have been more abidingly true had it been reserved for one of the happier valleys farther south. The winters are frequently so dry as to injure the pastures, although this is the rainy season of the year, while the rainless summers wither the grasses and give the whole countryside a parched and

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\* A Naturalist's Voyage. Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H. M. S. *Beagle* Round the World, London, John Murray. Ed. of 1890, p. 323, *et seq.*

brown appearance. The Valley of Paradise is, therefore, an intermediate tract receiving uncertain quantities of winter rain, a border region looking on the one hand toward the better-watered southern valleys, on the other hand toward utter desert, the region to which Darwin said he was tired of applying the epithets "sterile" and "barren."

Between Quilimari and Conchali, 60 odd miles north of Valparaíso, the country becomes more and more barren. In the valleys there is scarcely enough water for irrigation and the intermediate land is so bare as not even to support goats. A thin sprinkling of vegetation appears only in spring after the winter showers. The cattle are then driven down from their summer pastures in the higher Cordillera to graze for a time on the meagre fields of the desert. Although Conchali is but a degree north of Valparaíso its rains are not expected to begin till the end of May, whereas at Valparaíso some rain generally falls early in April. As the time during which the heaviest rain falls is limited pretty closely to the height of the winter season, which, in the desert and the mountains, corresponds closely to the time of the winter solstice, this late beginning of the winter showers is sufficient index of the small total precipitation.

At Coquimbo, farther north, the rains are still lighter. The farmers break up their ground after the first shower, sow their seed if a second occurs, and if a third shower falls reap a good harvest in spring. The farms on the sea coast are more fortunate than those up-valley for the cooler and more humid atmosphere retards the evaporation of the precious rain. Ten days after a shower all the hills are faintly tinged with green, the grass being sparingly scattered in hair-like fibres a full inch long, whereas, before the shower the surface appeared as bare as a highway.

In the Guasco Valley, latitude  $28^{\circ}$  S. and north of Coquimbo, rain is practically absent for 3 or 4 years in succession, only one or two showers falling during that time. A rainy year generally follows this dry period. The rains may then do more harm than the drought. The rivers swell and injure the irrigating ditches, strewing great banks of infertile gravel and sand upon the cultivated terraces. The Guasco Valley is typical of many of these desert valleys in having a line of towns along it. At the mouth there is the desert port, without any water in the immediate neighbourhood; five leagues higher stands Feyrina, a long, straggling village; ten leagues further is Balnear; and above this the horticultural town of Guasco Alto, famous for its dried fruit. The towns are supplied with water from the

melting snows in the far-distant Cordillera and their fortunes are thus bound to the vicissitudes of the mountain storms and the changing temperatures. Heavy snows, with high temperature succeeding, mean prosperity and happiness in the valleys; the time of light snows is the time of want. In these valleys of Copiapó, Huasco, and others adjacent, the inhabitants watch a storm over the Cordillera with great interest, as one good fall of snow provides them with water for the ensuing year. Without snow, desolation extends throughout the valleys. Several times before mining development began, nearly all the inhabitants of the valley of Copiapó were obliged to emigrate to the south. Darwin states\* that, in the year of his visit, there was



LOOKING EAST, NEAR THE PORT OF PISCO, PERU, AT THE CITY OF PISCO.

An irrigated cotton field is in the foreground and middle distance. Water is supplied by a mountain stream. The extraordinary fertility of the soil and the luxuriance of the foliage are in marked contrast to the desolate aspect of the port and the country immediately adjacent.

plenty of water and each man irrigated his ground as much as he chose, but that frequently it had been found necessary to post soldiers at the sluices to see that each estate took only its proper allowance. The valley was then said to contain 12,000 souls with produce sufficient for three months only, the rest of the supply being drawn from Valparaiso and the adjacent valleys of Chile.

Every winter the inhabitants hear with envy of the rains to the south and hope, without fail, for a share in the good fortune of their neighbours, even though their hope is seldom realized. For a mod-

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\* *Ibid.*, p. 336.



erate rain is a distinct addition to their mountain supply. It falls alike upon the valleyside farms of the poor and valley bottom lands of the rich and means relative plenty for all in the year to come. Even the mendicant shares in the general happiness as the more bountiful harvest is reflected in the increased generosity of his prosperous patron. The chief advantage of the occasional rain is not, however, in the water it supplies to the valleys but in the pasture it creates afield. The cattle and mules then range over the desert and the lower slopes of the mountains and, for a time, relieve the valleys of the burden of their subsistence.

Darwin also notes\* the belief of the inhabitants in some connection between earthquakes and rain. It is the more interesting in this locality because the extreme infrequency of rain reduces the probability of accidental coincidences. Furthermore, rain sometimes follows earthquakes at the dry period of the year when the rain is a greater prodigy than the earthquake. To the minds of the inhabitants an earthquake foretells rain as surely as rain foretells abundant pasture. On Darwin's mentioning the shock at Coquimbo to the people of Copiapó they immediately cried out: "How fortunate! there will be plenty of pasture here this year."†

The intermediate part of the west coast desert, which is most arid and inhospitable to man, is typified by the conditions that exist in the desert of Tarapacá which, with Atacama, constitutes the northern half of Chile. Considered from the standpoint of man it is even more interesting than are the ends of the desert where the transition is made to more favoured lands. The study of this section of the desert and the relation of its people to the sea and the Bolivian hinterland was one of the chief objects of the Yale South American Expedition of 1907.

#### THE TARAPACÁ REGION.

It is the special quality of the desert of Tarapacá that, in general, its eastern marginal streams from the high Andine plateaus and mountains do not, as elsewhere in the desert on the west coast of South America reach the Pacific. In the geomorphologic view, it is the only truly desert portion of the entire arid coast. For a desert, in the geomorphic sense of the word, is defined as a region of interior basin drainage whose streams at first discharge centripetally with respect to the initial basins to which they are tributary, this condition being followed by drainage integration and desert leveling. While this definition of the desert is, in general, appropriate enough in the

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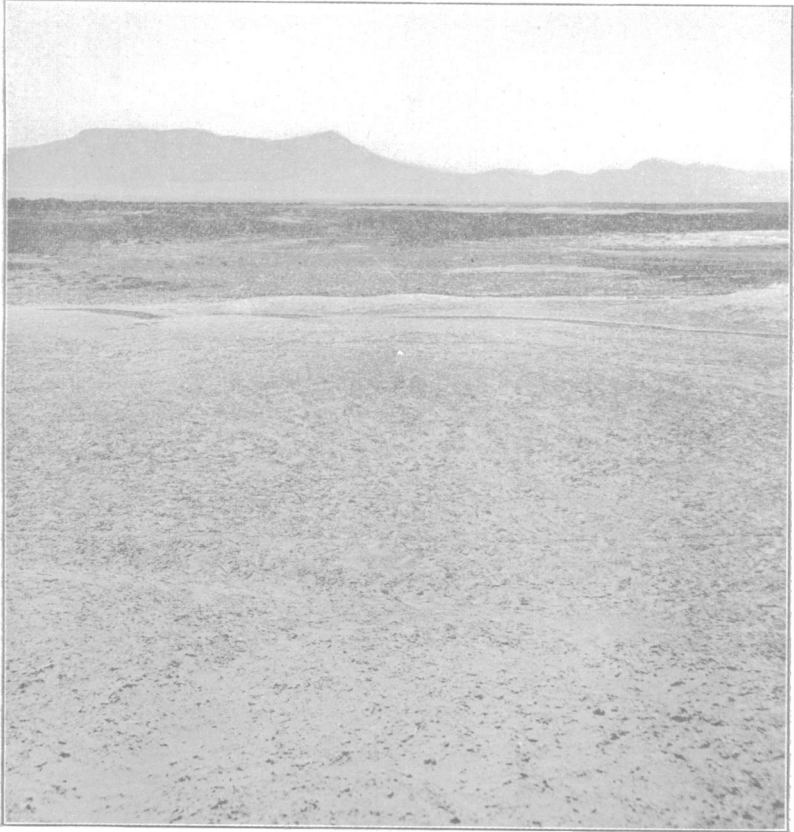
\* *Ibid.*, p. 337.

† *Ibid.*, p. 337.

interpretation of desert physiography there are very important exceptions. Along much of the west coast of South America, save for that small portion east of Iquique and a few hundred miles long north and south, the desert of Tarapacá, the pronounced westward slope of the western margin of the uplifted peneplain now constituting the Maritime Andes, has completely overcome the effect of the minor deformations. It is these minor irregularities that, with a less pronounced regional slope, generally give rise to a system of interior basins with characteristic centripetal drainage. The entire coast, from Payta, in northern Peru, to Valparaíso, in central Chile, with the single exception of the Tarapacá region, is, therefore, characterized by the absence of interior basins, notwithstanding its almost absolute aridity. It is, indeed, a desert in the truest sense of the word if we define the desert, as it should be defined, not with respect to geomorphic conditions wholly, but also with respect to those conditions of water supply which lead to the development of a sparse and specialized population. The geomorphic considerations are of great value, however, as they lead us to grasp the more readily the nature of structure and topography and their controlling influence over the space relations of streams, mountains, and sea. Throughout the desert on this west coast of South America the rivers, though more or less intermittent, in general reach the sea; the drainage is, in general, at right angles to the shore line, not centripetally arranged; the population is oriented with respect to the coast and the coast valleys, not with respect to a system of interior basins; the sea, not a line of oases, is the great highway of the region, the great unifier. The only exception is the desert of Tarapacá.

If we contrast Tarapacá with that portion of Atacama in central Chile, we see that the latter has a valley system related to the sea and that the last important valley toward the north from the southern end of the coast desert is Copiapó. From this point on, the streams of the Maritime Andes are lost in a line of salars or salt-encrusted plains, occupying the broad depressions, the interior basins between the low coast ranges and the foot of the Cordillera. The sole exception is the Loa River north of Antofagasta, whose more important features will be set forth in detail in a later paragraph. From the mouth of the Copiapó toward Antofagasta only one short, unimportant stream, fed from the trifling and uncertain showers that fall in the Coast ranges, descends precipitously to the sea. It occupies the miserable little valley of Paposo, 25° S., and is a fit ending to this line of dwindling streams. The only vegetation found north of this wretched valley is that already described as

occurring at the level of the cloud canopy that hangs over the edge of the land. At this level, tiny oases may occur if the situation is peculiarly favourable. Thus, 8 miles back of Antofagasta, at an elevation of 1,600-2,000 feet, is a bright little spot of grass and flowers caused by the heavy dews and mists. Some goats are raised and even a few vegetables. The goats sip the dew from the spoon-shaped cactus leaves in which it gathers, a spoonful or more, in each.



VIEW OF THE COAST DESERT BACK OF THE PORT OF ETEN, PERU.

In the middle distance is a slight sprinkling of vegetation upon the valley flat of a stream heading in the mountains.

What with this and an occasional drink of salty water from some stagnant pool they are able to subsist.

Toward the north, the streams of the Maritime Andes find the sea again at Pisagua, where the volcano-crowned plateau swings toward the west. Thus, for 500 miles from Copiapó to Pisagua, the Loa is the

only river of any consequence that reaches the sea and it accomplishes this only in years of heavy snowfall in the mountains. In all this stretch of desert the coast ranges are thus broken but once. The mountain streams dwindle and fail on the inner side of the desert where their waters are absorbed by the deep porous sands and gravels that form a piedmont slope 350 miles long.

Each failing stream—Aroma, Tarapacá, Huaschiña, Mamiña, Quisma, Salado, Huataconda, Chacarilla, and others—is the locus of a village or a line of villages. Each stream is deeply incised below the level of the broad slope that directs it westward to the inner eastern edge of the desert. Thus there are two chief classes of routes of travel: east-west routes along the axis of the incised streams; and a north-south route at the inner edge of the piedmont where the streams terminate. The trails are for this reason arranged in a roughly quadrilateral fashion. Within the mountainous area of the plateau, where numerous volcanic peaks occur, the trails are more irregular in direction, but along the inner (eastern) edge of the Maritime Andes the bold scarp, which forms the western limit of the central salars of Bolivia, again determines a north-south highway of travel and trade. Departures from this quadrilateral pattern are numerous but the travel over them is in general much less than over those arranged in conformity with the major topographic and drainage outlines. In addition, the departures are difficult trails zigzagging up and down steep-sided and deep quebradas or gorges and often traversing the most difficult sandy wastes.

An examination, either of the history or the present condition of the villages occurring at the mouths of those valleys having a permanent water supply, leads to the conclusion that they, of all the desert places of South America, have been bound to the wheel of physical circumstance. In no other localities have the local times and seasons been so clearly reflected in the fortunes of the people. Elsewhere there have been means of escape if Fortune frowned too sternly, as when the inhabitants of Copiapó three times emigrated to the south. But Copiapó is in touch with the sea—its valley opens out upon the coast. On the other hand, so far as these interior villages were concerned, as well might the coast be a thousand as a hundred miles away. Their streams wither far from the sea, and naked desert and an uninhabited coast repelled all occupation or movement in that direction. The fortunate places were in the mountains and on the inner edge of the desert, away from the sea. And there they are to-day for any population unit which must subsist upon what it produces from the soil. Before nitrate and copper

were produced and the modern artificial coast towns—Iquique, Pisagua, Tocopilla, Culeta Buena—came into existence, the coast ranges and the wellnigh impassable desert, intervening between them and the Andes, might have been a great continental desert interior, like “The Dead Heart of Australia.” Its effect could have been no greater upon these inner desert towns. They looked to the mountains for their subsistence, not to the sea. It was of far more importance then that the winter’s snows, whose amount they marked with great concern, should be unfailing, than that the vessels of distant ports and countries should ride at anchor off their repelling and distant shores. Incredible as it may seem from an examination of a small scale map of South America on which these towns appear almost on the coast, it is yet true that before the nitrate business was established, the isolation of these towns was almost as complete, their connection with the sea almost as remote and unimportant as is that of the similarly located piedmont towns of the northern slopes of the Kuen-lun and Altyn Tagh Mountains of Central Asia so graphically described by Huntington.\*

The sea and the desert were one in the absence of any easy means of securing food from them. And the oases, separated by wide stretches of utterly barren rock and sand, were like oceanic islands in the degree of isolation they possessed. In them no single movement of any consequence was ever originated. Economically they are the least important units in Chile. Their chief consequence to the world of progressive men has been their service to land travellers who have utilised them as links in the chain of communication from central Chile to southern Peru, and from the mountainous hinterland to the coast. For example, they were determining forces in the extension of the Inca Empire. Their absence would have meant a more northerly frontier. They furnished food and water and men to the imperial armies and constituted bases of operations in the progressive conquest of the southerly lands. They were population units incapable of any initiative and only passively and, in a certain sense, unconsciously serviceable to movements initiated in less hospitable regions nearby. Almagro’s army would have perished to a man, as, without ships and with an uncharted ocean of sand and salt before them, they made their precarious way northward from central Chile, had it not been for the occasional oases scattered along their line of march. The prospectors of a later day and the traveller of the present use them to similar purpose. Without them the desert

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\* “The Pulse of Asia,” p. 153, *et seq.*

would not be traversable except at enormous expense of money and energy and time.

It is quite commonly supposed that in every desert where people reside there is subsistence for beasts beyond the margins of the oases. It is easy to see how this supposition originated. From the earlier generalized picture of the desert as a rainless, unpopulated, sandy waste, some have turned to another scarcely less inaccurate, that represents all deserts as habitable places with sufficient drought-resisting vegetation scattered about to sustain at least a pastoral population. What both conceptions lack is an appreciation of the variety that deserts, as all other lands, display in the matter of habitability. It was believed after Frémont's exploration in our Southwest that "The Great American Desert" was one of the formidable deserts of the world; later study of the whole, and the partial occupation of exceptionally well-favoured areas within it, have led a considerable body of loose writers to discard the phrase entirely and look upon the whole of our vast public domain in the West as habitable. Yet there are 70,000,000 acres of intensely desert land\* there to-day not reclaimable even for grazing by the existing resources of science. Likewise in the case of the Sahara some have expressed too emphatically its universally desert character, a too hasty generalization based on an intenser study of and greater familiarity with the uninhabited places. To this the recent works of Gautier and others have supplied a useful warning in pointing to the large inhabited areas†, not to mention the ultimately inhabitable regions not yet occupied by man.

It has already been noted that no vegetation can be found from 2,000 feet to 8,000 feet, in these portions of the deserts of Atacama and Tarapacá, except where the mountain streams debouch upon the piedmont slope. It is a thoroughly plantless region; not even that almost universal sign of the desert, the cactus, can be found; downright nakedness prevails. This complete barrenness of the desert pampa, outside the borders of the oases, at once denies even a pastoral occupation over the wide expanses of the region. Flocks are kept in certain numbers but they must forage on the cultivated plants of the garden farms: alfalfa, millet, etc. Not even the temporary range noted at Payta and Copiapó, and due to an occasional shower, exists here. Beyond the oases there is nothing, except in the mountains above 8,500 feet, and access to these exceedingly thin mountain pastures is denied over much of the year by the extreme

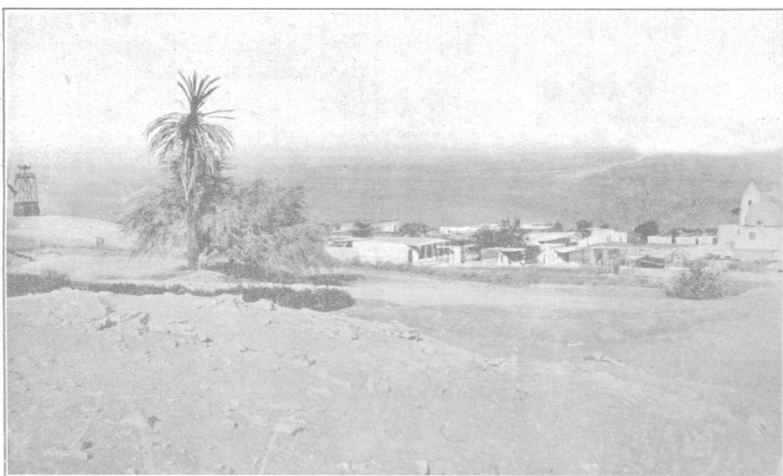
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\* "Irrigation in the United States," F. H. Newell, 1902, p. 28.

† "The Desiccation of North Central Africa," *The Monthly Record, Geog. Journ.*, June, 1908, p. 676.

scarcity of springs and streams that may be relied upon for drinking water. Only during a few months of the spring can certain restricted areas of mountain pasture be relied upon. Of other pasturage there is none except in some under-developed oases where poorly watered marginal tracts, rarely more than a few square miles in extent, support a wild growth of temporary grasses and perennial shrubs which, for a short time, bear certain quantities of succulent foliage.

The population, by reason of its aloofness from the ocean and the lack of herbage afield, is sedentary to a degree. It consists of farmers deeply rooted to that portion of the soil watered by the mountain streams. Each agricultural or horticultural area is to a high degree



ON THE EASTERN EDGE OF THE DESERT OF TARAPACÁ.

Looking west at the oasis of Matilla in Chile. The situation is east of the great nitrate port, Iquique. The coast ranges, 30 to 40 miles away, may be identified in the background. The white band in the right middle distance is the broad trail leading from Pintados, on the railway from Iquique to the nitrate establishments at Lagunas, to Pica, the large oasis a few miles east of Matilla. The tower on the left is for the light which guides the night traveller to the village. The Quisma River, fed by light uncertain rains and melting snows, here irrigates some of the most beautiful gardens in Chile. It terminates a mile or more beyond Matilla, except at times of flood. The flood waters are partially impounded in a reservoir from which they are gradually delivered as needed.

a self-centered unit. Formerly this quality was much more evident than now. To-day the great industrial development which the exploitation of the nitrate has brought about has stirred the oases dwellers out of their lethargy. Fruit is required at Iquique, and Pica and Matilla supply a part of it, and thereby acquire a taste for the products of the town. Labourers are in high demand all through the nitrate region and the populations of the oases, crowded from

the standpoint of water-supply and food resources, are often drawn upon for the service of the nitrate oficinas or establishments.

Yet the material independence of the oases peoples is clearly persistent to a certain degree even to-day. It is a product of the wide spaces between population units. No better example could be cited of man fighting sheer space, with less to be gained at the end of the fight, than here. When one conquers the waste spaces of the sea he has, within certain rather wide limits, his choice of lands to touch and products to secure; but here, a similar climate and similar conditions of soil and water-supply are reflected in a damning uniformity of agricultural products. The clearest working of the economic law this embodies is seen in a year of misfortune at any one of the oases, the adjacent ones experiencing a normal year. Thus a dam sometimes breaks, and the accumulated waters rush through the fields and terraces of the intensively cultivated valley and wash out a large share of the crops for the year. The emptied reservoir remains dry until the following season and discomfort, if not actual want, prevails in the valley. The thinkable consequence of this condition is that the surplus products of a neighbouring valley are brought to the stricken group. Instead, the long distance to be overcome and the consequent high cost of transportation to be met by the consumer all but forbid such a course. The consumer has no resources to speak of and must buy cheaply or not at all. He can endure want but he cannot buy what he has no money and no way of getting money to pay for.

There is clearly in this case a relative economic loss and in some cases the loss is absolute, as when an unused surplus of perishable fruit or bulky forage is not sold to a neighbouring valley.

As a consequence of the wide spaces to be overcome with perishable or bulky goods, or even any goods at all, the prices for staple commodities vary greatly from place to place. In May, 1907, we found free pasture at the uninhabited grassy camp known as Chaia, a tributary of the Chaqarilla gorge; at the oasis of Chaqarilla a half-day's journey west, forage was free, if the natural growth was desired; a few shillings the quintal, if it consisted of barley from a cultivated terrace; while at Pica, 30 miles northeast, it was 8 pesos, or \$2 gold, per quintal. Where there is none to spare sometimes money cannot buy forage even of the worst kind; where there is plenty, it is very cheap; where there is a surplus it is given away, and where there are no inhabitants it belongs to the first comer. It is the ratio of supply to demand at a given restricted and isolated locality that determines the price, not the ratio of the aggregate



supply to the demand of the whole geographic province. In short, there are no railroads and only the most primitive means of carriage for freight and passengers; and no specialized production or adequate equalization of surplus products of any kind. Furthermore, these primitive means of communication mean great expense. The prices for food, fruit, forage, and the like are as high in many places as in New York City. The price depends on the locality, the extent to which the commodity is locally produced, and the degree of abundance of the crop for a particular year.

In general, one must grow one's own produce or live very expensively. A wine produced at Pica, Chile, can be purchased for a fraction of a dollar a bottle; imported wines cost, if one can get them at all, nearly \$2 per bottle. In Italy or France one can purchase flask and wine of precisely the same kind for a few cents. Only a rich mine or a thriving business enables one to live permanently upon the market and not have one's own vine and fig tree. To the costly and hazardous transportation and the fact that each man lives for the production of his own food there is the increment which represents the necessity of overcoming the inertia of the native. He has no ideals of the sort we know and live for. Wealth to him is the possession of comfort of a sort we would regard as miserable. Drink, gaudy attire, and long leisure to enjoy them, are in a way objects of veneration to many of the Indian inhabitants and, in a large measure, it is true that only for them and the sterner necessities born of the meagre years will be produced, even for pay, what another man is to consume.

It may, therefore, be said that in general the commerce of these towns is decidedly feeble; is carried on under great difficulties and tends toward no natural self-initiated improvement, but rather stagnation, because the products are, on the whole, not of a complementary nature. The interchange of products is only important under fortuitous or local conditions as when clay deposits occur at one locality and not at another, and so lead to the production of pottery; or where the culture of the grape is happily joined in one place to a good water-supply, and the production of exceptionally good wine thus becomes a tradition. At present there is also a certain activity due to the opening up of mines in the mountains. The surplus products of the oasis of Chaquarilla are disposed of at the Victoria mines, a few miles away, while some fruit and dried meats are taken from Pica and Matilla to the mines at Huataconda and Chaiahuasi, a week's journey over a steep trail.

The precarious situation of most of the towns is one of their strik-

ing characteristics. The least accident may betray them. This is well illustrated by the history of a line of settlements in the Chaquarilla Valley. It was at one time a fertile and frequently visited district. But in the early 70's, as nearly as we could determine, a great flood came down the gorge, broke down the irrigating ditches, cut up the terraces or deposited infertile sand, gravel, and even boulders upon them, overwhelmed orchards, and so generally devastated the farms and discouraged the inhabitants that all but a remnant of them moved away. Their irrigation works may still be seen at the site of the now deserted village of Algorrobal. Here and there a neglected orchard tree or pepper bush, struggling along as best it can without irrigation, or the crumbling mud walls of some abandoned home are a mournful testimony to the ruin wrought by the flood in this once happy valley.

The fragment of people now living within sight of the former more populous valley occupies a safer position. The tiny oasis of Chaquarilla is perched high above reach of flood upon the slopes of a terraced alluvial fan, whose outer edge is protected by a stone wall. The small spring-fed stream discharging across the fan is led out upon the gardens and orchards by half a hundred diverting canals. Before the mines were opened it was a lonely spot and it is said that it was once attacked by robbers from the pampa to the west. It was supposed that stores of treasure had been accumulated from the mysterious mountains behind them. Nothing, however, was found and the murder of most of the inhabitants was but a dismal butchery.

The future of these piedmont and mountain valley towns is safely predictable. The small area of irrigable land, even with the maximum conservation of water-supply, means definitely restricted groups of population widely separated from each other and as stagnant and self-dependent as isolated. Their limited development and the wide unproductive spaces to be overcome will always mean the absence of any improved means of communication and no assistance can be expected in this direction. Railroads will never connect these towns except as they lie by chance upon the line of some future route between mine and seaport. Pica is the largest town along the mountain front and a branch line but 14 miles long would put it in touch with the port of Iquique via the Lagunas-Iquique nitrate railroad. Yet that short line has not been built and probably will never be built. Consequently, the outlook for the smaller towns in remoter localities is that of a continuance of the present economic state unless fortuitously assisted by roads built to the mines or stimulated by the demands of nearby mines, the exceptional richness of whose ores will make possible the costly transportation by carts and mule packs

to the coast. The latter means are not found generally successful today with competing mines more favourably located with respect to railroads. The mines back of Taltal, for a long time exporting their ores by cart to the seaboard, had to be abandoned when the mountain railroad from Antofagasta to Oruro was completed. The future of mining in this part of South America will be bound up with the future railroad development of the country now that railroad building has been actually begun. Before any railroads at all were built, or when



CROSS ERECTED UPON A "SIGNO DEL CAMINO," OR SIGN OF THE WAY.

The natives believe that it is a preventive of extreme drought in the valleys of the near-by streams.

only a few were completed, such competition could be continued. With the active extension of the railroads in South America, that phase of mining development has well nigh passed. The remote, isolated, self-dependent, desert village is therefore a permanent feature. The traveler of a century hence will still find certain groups

unaffected, in the main, by the industrial development of the mines and the nitrate deposits of the desert of Tarapacá.

In spite of the disagreeable odours and filthy sights one sees about these towns, one's first and last impression of them is enduringly pleasant. From the desert trail, long, hot, and deep in dust, their inviting gardens are seen many leagues away and at night a tower light on a commanding hilltop guides the traveler to their hospitable gates. Rows of refreshing orchard trees, neat squares of vegetable gardens, and a life-giving stream with clustering houses—that is the picture. In the twilight of morning and evening, the strong contrast of yellow plain and deep green foliage is most marked and lends to the view, in that otherwise cheerless land, an indescribable charm. There is a universal appeal in this aspect of home and a certain comfort and beauty amid the inhospitable surroundings of a naked desert.

Each town has its patron saint, appropriate to the specialty for which the town is known or the condition under which it exists. St. Andrew, the patron saint of wine, is the patron saint of Pica, where excellent wine is produced; San Isidro, the patron saint of farmers, is the patron saint of Canchones, where, without a surface stream, the farmers still persist in agriculture by digging canals and great holes to the ground water, and in these they plant their grain and vegetables. Frequently the saint of one village is taken on a trip to a neighbouring village. Thus, at the time of our visit to Pica the Virgin of Candelaria was brought from Macaya, a copper-producing village of 600 inhabitants, 60 miles northeast of Pica. She came asking for alms, for it had proved a hard year at Macaya and an appeal was thus made to the generosity of the inhabitants of Pica. Their patron saint was carried out to meet the visiting saint and with fife and drum the united procession returned to the village, parading the streets to the church of St. Andrew.

Throughout many portions of this thinly populated, arid region of South America, there is the most curiously interesting mixture of primitive and Christian worship. The old rites of the Indians are grafted upon a new principle, often with but a change in name and not in symbol. The spirit of the old prayers for abundant rivers and rich harvests breathes through the new devotions and the quaint, melancholy songs of the ancient Quichua or Aymara tribes often follow upon a fiesta in which the rites of the Christian religion are but new forms for an old and pathetically simple speech. The rivers and the harvests are the forms in which they understand the Deity. It is hard to teach men new faiths or religious or moral niceties whose first and only prayer has always been for the daily bread fairly wrung from a stubborn earth.